Space Weather Technical Forecast

Issued on Saturday, 01 January 2022 at 12:54 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor storm on 01 January.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with a long duration M1.1 flare at 01/0730 UTC originating from AR2918 (Bxo/Beta) in the northwest quadrant. There are five regions on the visible disc. AR2916 (Ehi/Beta-gamma) has seen some fading of intermediate spots, but is still large with a complex magnetic structure. AR2918 (Bxo/Beta) produced the aforementioned M-class flare. This region will be rotating off the disc in the next 24 hours. AR2922 (Cso/Beta) in the southeast and the newly numbered AR2923 (Cro/Beta) to the south of 2916 appear stable with simple magnetic structures, as does AR2919 in the southwest. No Earth-directed CMEs have been observed on available imagery though further analysis will take place once more imagery becomes available from the earlier M flare.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1, started the period at around 430 km/s before declining back to near background levels of 400 km/s by 01/0001UTC, however after this time Earth has connected with the High Speed Stream from CH40/+. This has led to elevated speeds around 550 km/s. Density had been steady and around average before increasing to above average levels around 12 ppcc following the arrival of the High Speed Stream. Total magnetic field strength had been weak before rising to Moderate levels around 10nT following the HSS arrival. The all-important north-south component Bz, has been predominantly weak, briefly reaching values of both +8 and -t nT. Phi angle was mainly positive (away from the Sun). Geomagnetic activity has been mainly Quiet to Unsettled (Kp 1-3) with a Kp 4 Active interval between 01/0300-0600UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy (greater than 2MeV) electron flux has been at background to moderate levels. Electron fluence was well below the Active (1e8 integrated pfu) threshold. Observed fluence at 01/0001 UTC was 6.48e6 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low or very low solar activity is expected, with a slight chance of further M-class flares from either 2916 or 2918.

Solar Wind / Geomagnetic Activity: A high speed stream in excess of 500 km/s from coronal hole 40 is expected to persist on day 1 (01 Jan). Speeds are likely to remain at this level through days 2 and 3 (02-03 Jan), but then start declining on day 4 (04 Jan). Geomagnetic activity is expected to be mainly Unsettled to Active with a chance of G1/Minor Storm intervals on day 1 (01 Jan), from day 2 the risk of G1 minor geomagnetic storms eases back to a slight chance with geomagnetic activity becoming mainly Quiet to Unsettled with a chance of Active intervals. No Earth-directed CMEs are in the forecast, though further analysis will be required once imagery becomes available following the M1.1 flare earlier.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, albeit with a very slight chance of S1 due to the potential contained within the two most significant sunspot regions. High energy electron flux values are expected to remain below the high (1e3 pfu) threshold on days 1 and 2 (01-02 Jan), with a slight chance of increasing above the threshold on days 3 and 4 (03-04 Jan) on diurnal peaks. Electron fluence is forecast to remain below the Active (1e8 integrated pfu) threshold, but with an increasing trend on 02 and 03 January.

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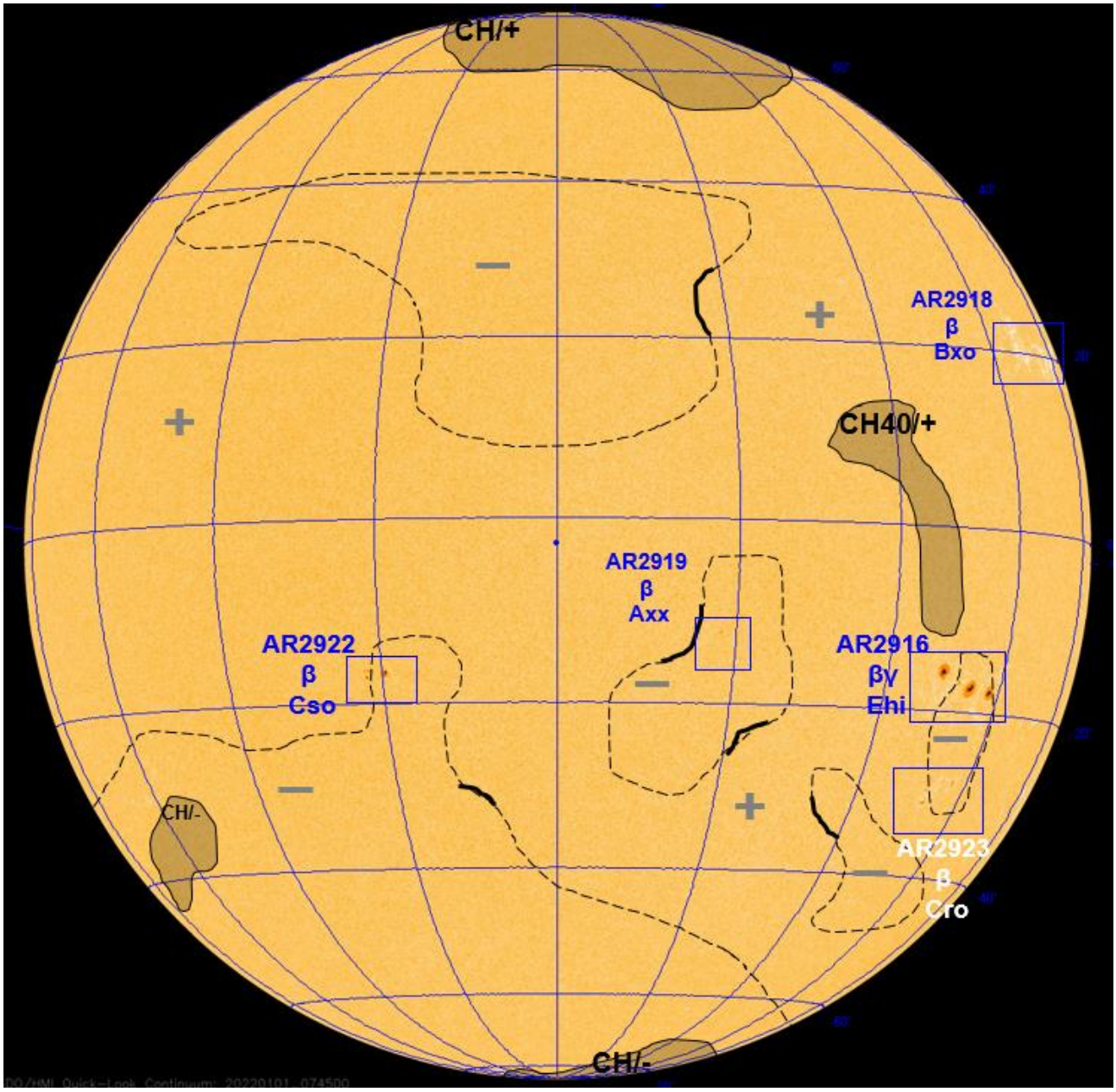
Figure 1. Solar Analysis Valid 01/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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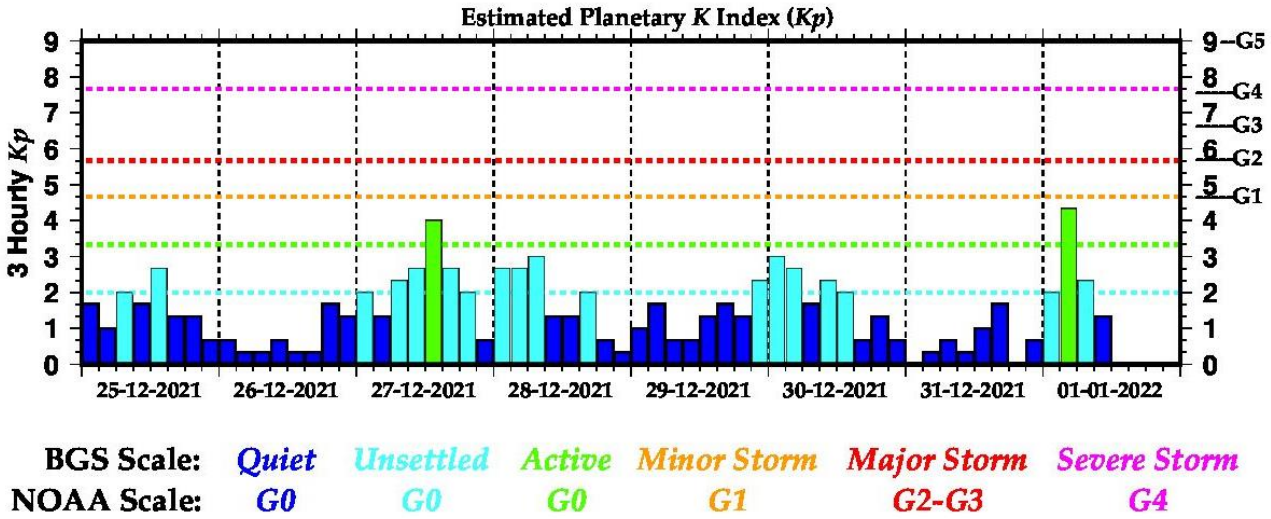
Geomagnetic Storms:

No Earth-directed CMEs are currently in the forecast, though further analysis will be required once imagery becomes available following the M1.1 flare earlier.
The high speed stream from coronal hole 40 has connected with Earth with speeds in excess of 500km/s observed at L1 and forecast to persist through day 2 (02 Jan). A decline in speed is then likely later on day 3 and through day 4 (03-04 Jan).
Geomagnetic activity is expected to be mainly Unsettled to Active with a chance of G1/Minor Storm intervals on day 1 (01 Jan), from day 2 the risk of G1 minor geomagnetic storms eases back to a slight chance with geomagnetic activity becoming mainly Quiet to Unsettled with a chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Kp index



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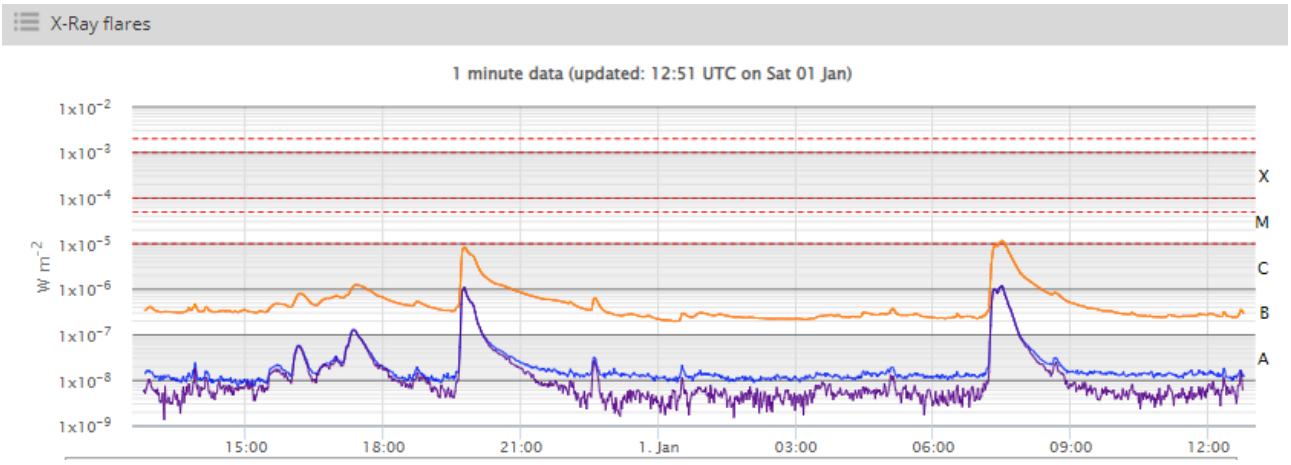
Radio Blackouts - X-Ray Flares:
Solar activity is expected to be low or very low over the next four days with only large and stable or small and benign sunspots on the visible disc.
AR2916 (Ehi/beta) is the largest region, but has not produced any significant activity through the last 48 hours. AR2918 (Bxo/beta) is following a declining trend, but recently produced an M-class flare, which suggests the possibility of significant flare potential as it continues to rotate towards the northwest horizon. The other remaining regions are all small, weak and stable spots.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	10	10	10
Very Active	R3 to R5 X Class	No	3	1	1	1

Figure 3: GOES16 X-Ray Flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist as such. Despite the apparent stability, 2916 and 2918 continue to be monitored for potential radiation storms.

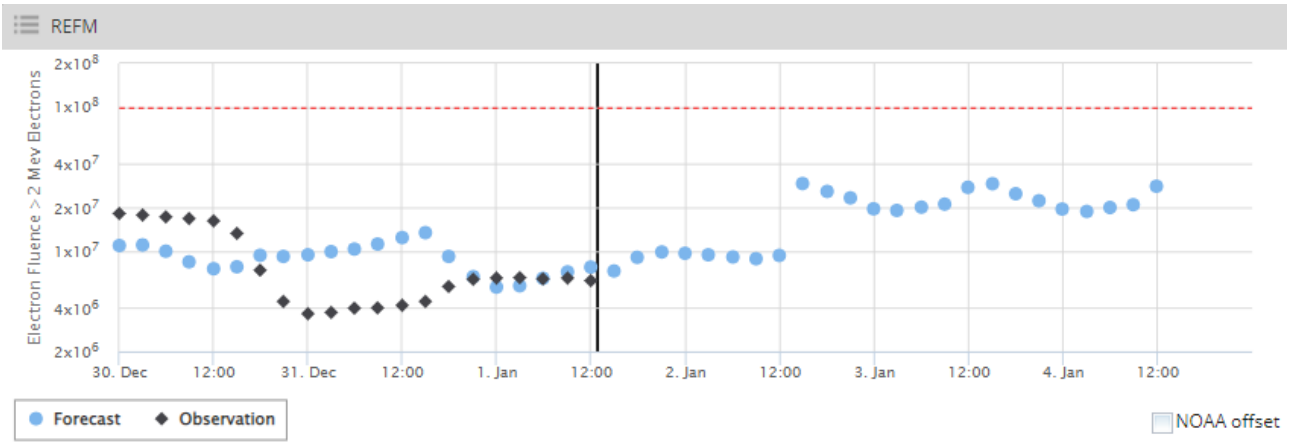
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is expected to be at background levels and may be constrained by any geomagnetic activity due to the onset of the high speed stream from coronal hole 40 on day 1 (01 Jan). Electron flux values are then likely to increase, with high (1e3pfu) levels possible at the diurnal maximum through days 3 and 4 (03-04 Jan).
Electron fluence values are forecast to remain below the Active (1e8 integrated pfu) threshold, but with a rising trend on days 3 and 4.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REF Model forecasting fluence values to stay below 1e8 alert warning level.



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